United States Senate
Republican Policy Committee
Jon Kyl, Chairman
Lawrence Willcox, Staff Director
347 Russell Senate Office Building
Washington, DC 20510
202-224-2946
http://rpc.senate.gov

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Missile Defense – Limited Defensive Capability

A Significant Step in Missile Defense History

Executive Summary

- The ballistic missile threat against the U.S. homeland has existed since the early 1960s; but now, with the placement of interceptors at Ft. Greely, Alaska, and Vandenberg Air Force Base, California, the United States has a limited defensive capability against a ballistic missile attack for all 50 states.

- Recent claims made by North Korean officials that their country has a nuclear weapon and is prepared to resume missile tests underscore the importance of U.S. efforts to develop a system to protect Americans from a long-range ballistic missile attack.

- The main focus of the Missile Defense Agency now is further testing and development of the ballistic missile defense system to improve upon this limited capability.

- While two recent integrated flight tests of the ground-based midcourse defense system did not have 100-percent successful results, they still yielded valuable information for improvement of the system.

- Several successful tests of other systems within BMDS should be noted. On November 10, 2004, MDA achieved "First Light" with the Airborne Laser – the first test fire of the system's laser. On February 24, 2005, the Aegis Ballistic Missile Defense system had its fifth successful intercept in six tests.

- This initial system is just the first step in a layered defense. The system will continue to be tested, refocused, and improved, and – given the changing nature of the security threats this nation faces – that is the most appropriate plan.

- While this phase is just the beginning, the initial system is a remarkable capability – one that the United States has sought since the V-2 missile first terrorized the Allies in the Second World War.

Introduction

Recent claims made by North Korean officials that their country has a nuclear weapon and is prepared to resume missile tests underscore the importance of U.S. efforts to develop a system to protect Americans from a long-range ballistic missile attack. With the placement of interceptors in Alaska and California last year, the United States has a limited defensive capability against the long-range ballistic missile threat from North Korea. This paper highlights the complex nature of missile defense development by considering our current limited capability within the context of prior U.S. efforts to develop defenses against various ballistic missile threats.

Progress in Missile Defense Development

The ballistic missile threat against the U.S. homeland has existed since the early 1960s; but now, with the placement of interceptors at Fort Greely, Alaska, and Vandenberg Air Force Base, California, the United States for the first time has an initial limited defensive capability against a ballistic missile attack for all 50 states.[1]

The importance of such a capability recently has been reinforced following claims made by North Korea regarding their nuclear weapons program. In February 2005, North Korean officials announced that their country has nuclear weapons.[2] In addition, last month a North Korean Foreign Ministry statement raised the possibility of resumed missile tests. The Korean Central News Agency quoted the statement: "There is now no binding force for us on the moratorium on missile testing. We are not legally bound by an international treaty, or anything else on the missile issue."[3]

This limited defensive capability consists of interceptors in Alaska and California with an inter-connected architecture of radars, sensors, battle-management systems, and command/control/communications systems. Were the missile threat to escalate further, this initial system could be placed on alert. If a country launched a ballistic missile at the United States, this limited defensive capability could then track, acquire (locate it in space and discriminate the warhead from decoys), and intercept and destroy the missile by colliding with it ("hit-to-kill" technology).

The initial Ground Based Midcourse Defense system includes six interceptors at Ft. Greely, Alaska and two interceptors at Vandenberg Air Force Base, California. The Department of Defense continues to place additional interceptors in the Ground Based Midcourse Defense, with up to 10 more interceptors expected to be installed at Ft. Greely in 2005.[4] The main focus of the Missile Defense Agency (MDA) now is further testing and development of the Ground Based Midcourse Defense system to improve upon this limited capability. The attached appendix notes the wide range of tests that MDA has conducted on the Ballistic Missile Defense System (BMDS). Since it is such a complex system, its capability is limited at first; but it will continue to be refined – and each new test provides valuable lessons learned for improvement of the system.

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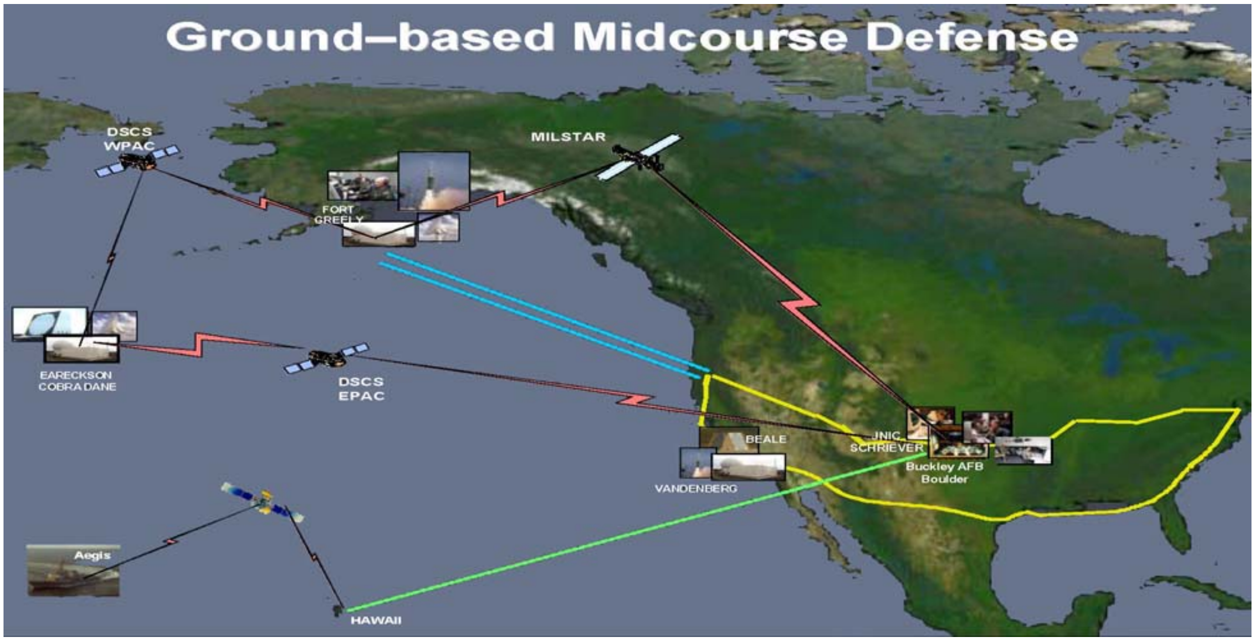
[1] The initial system is focused on the most immediate threat to the U.S. homeland of ballistic missile attack originating from Northeast Asia.
[2] Korean Central News Agency of the Democratic People's Republic of Korea (DPRK), "DPRK FM on Its Stand to Suspend Its Participation in Six-Party Talks for Indefinite Period," February 10, 2005.
[3] Reuters, "North Korea Threatens to Resume Missile Tests," March 3, 2005.
[4] MDA, "Missile Defense Agency Emplaces First Interceptor at Fort Greely," Press Release, July 22, 2004.



The initial Ground Based Midcourse Defense consists of interceptors, radars, sensors, battle-management systems, and command/control/communications systems. [5]

Brief History of Missile Defense Development

Pre-Strategic Defense Initiative

A brief review of the history of missile defense development highlights the significance of the limited defensive capability inherent in the Ground Based Midcourse Defense component of a layered missile defense. The deployment of a missile defense that could protect the entire territory of the United States has always been a technical challenge. Considered against the 60 years the United States has sought missile defenses, the current system developed and tested by MDA using hit-to-kill technology demonstrates what technological ingenuity, combined with political determination, can yield.

Project Thumper/Project Wizard. As early as 1945, American researchers considered how the United States might field a defense against the new threat of ballistic missiles demonstrated by the German V-2 rocket. In March 1946, the Army Air Forces "initiated two long-term studies, Projects Thumper and Wizard, that were to explore the feasibility of developing interceptor missiles."[6] Initial research indicated a defense was not feasible with the

[5] BMDS: The aggregate ballistic missile defense (BMD) battle management/command, control, and communications (BMC^3) and BMD forces that, in total, provide defense against ballistic missile attacks to North America and other areas of vital interest. Components of the BMDS include integrated systems designed to destroy an enemy ballistic missile during its boost, midcourse, and terminal stages of flight. Some examples of component systems of BMDS include: the Ground-Based Midcourse Defense (GMD) system; the Aegis Ballistic Missile Defense (Aegis BMD); Airborne Laser (ABL); and the Terminal High Altitude Area Defense (THAAD).

[6] MDA Historian's Office, "Missile Defense Timeline: 1944 – 2003," available at: http://www.acq.osd.mil/mda/mdalink/html/history.html; for more information on the pre-Strategic Defense Initiative missile defense programs also see: MDA Historian's Office, "Ballistic Missile Defense: A Brief History," and Daniel S. Papp, "From Project Thumper to SDI: The Role of Ballistic Missile Defense in U.S. Security Policy," *Aerospace Power Journal*, Winter 1987-88.

technology available, but developments by the mid-1950s began to yield a feasible technical concept for a ballistic missile defense.[7]

Nike-Zeus. The first true U.S. antiballistic missile project was Nike-Zeus, successor to Nike-Ajax, an antiaircraft project. Then Secretary of Defense Neil McElroy directed the Air Force to scale down Project Wizard in January 1958 and assigned primary responsibility for the ballistic missile defense mission to the U.S. Army, which had developed the Nike-Zeus program. In 1957, the Army began the Nike-Zeus Guided Missile Defense System Project, which focused on the use of a single low-acceleration missile, armed with an atomic warhead and guided by a basic radar system.

Nike-X. Following classified work in 1962, the Nike-X development program was publicly revealed as the successor to Nike-Zeus. Nike-X included a high-acceleration interceptor (the Sprint missile) and phased-array radars.[8] Tests of the Nike system in 1962 demonstrated the ability of an interceptor to come within 2 kilometers, and later 200 meters, of the target – both close enough for a successful intercept if a nuclear weapon were used to destroy the incoming warhead.

Sentinel. Following unsuccessful attempts to reach an agreement with the Soviet Union to ban or limit missile defenses, the Johnson Administration in 1967 announced the planned deployment of a ballistic missile defense system named Sentinel. The system was based on Nike-X. The Spartan missile was to defend against warheads outside the atmosphere, and the Sprint missile was to defend against warheads that entered the atmosphere. Both would fly close to the incoming missile and then detonate a nuclear weapon to incinerate the enemy warhead. The system was to include 17 sites, including 15 in the continental United States — of which 10 were to be near major urban areas. The decision to deploy Sentinel was halted in 1969 as the Nixon Administration came into office.

Safeguard. In early 1969, President Nixon announced that the Sentinel system would be re-oriented to protect U.S. inter-continental ballistic missile (ICBM) ground stations from attack, and renamed it Safeguard. Deployment of Safeguard would have included the capability to defend urban areas against the Chinese nuclear threat or some accidental launch. Original deployment would start with protection of two ICBM fields (collection of ICBM missile silos), with periodic reviews and revisions to determine whether deployment should be accelerated, altered, or stopped. When complete, Safeguard was intended to have 12 sites at a cost of $7 billion.

ABM Treaty. Following the first round of the Strategic Arms Limitation Talks (SALT) between the United States and the Soviet Union in November 1969, the Anti-Ballistic Missile (ABM) Treaty of 1972 was reached. The ABM Treaty limited both countries to two missile defense sites, each one having no more than 100 interceptors. The ABM Treaty prohibited: the development of a ground-based missile defense capable of defending more than one location; sea-based missile defense development; advanced sensors; space-based sensor development; and allied cooperation. A 1974 protocol modified the ABM Treaty to allow only one site for each country. By the time of the protocol, the United States was nearing completion of its one

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[7] David N. Schwartz, "Past and Present: The Historical Legacy," *Ballistic Missile Defense*, The Brookings Institution, Washington, D.C.: 1984.
[8] A phased-array radar can be used for searching or tracking a target. The radar requires no physical movement, but the beam can be steered by electronically adjusting the signals to each antenna.

Safeguard site, located near Grand Forks, North Dakota. In February 1976, a few months after the Safeguard site became operational, Congress directed the Defense Department to close the Grand Forks facility due to Safeguard's technical limitations (primarily that its radars were vulnerable to Soviet attack and that it had to carry a nuclear weapon to destroy an incoming warhead).

Strategic Defense Initiative (SDI)

SDI's Initial Concept and Development. Spurred by concerns that the Soviet Union had improved its nuclear first-strike capability, President Reagan announced in 1983 his decision to initiate an expanded research and development program "to counter the awesome Soviet missile threat with measures that are defensive."[9] Following a technical and strategic study of missile defenses, SDI was established on January 6, 1984 to "investigate the feasibility of eventually shifting toward reliance upon a defensive concept."[10] Over 20 years ago (June 10, 1984), the Army demonstrated a successful "hit-to-kill" intercept test.[11]

By December 1986, Secretary of Defense Caspar Weinberger initiated the first phase of a theater missile defense architectural study competition, and the following summer, the baseline architecture resulting from the competition was approved. The six subsystems to be developed for demonstration of the system were: a space-based interceptor; a ground-based interceptor; a ground-based sensor; two space-based sensors; and a battle management system. Construction on the National Test Facility began in 1988.[12]

Brilliant Pebbles. In February 1989, the outgoing director of the Strategic Defense Initiative Organization (SDIO), General James A. Abrahamson, voiced support for the Brilliant Pebbles concept. Brilliant Pebbles stood in contrast to the space-based interceptor concept of the original architecture, which would have been a large, garage-like satellite housing a number of interceptors. The housing for the interceptors would have been vulnerable to Soviet anti-satellite weapons and also was prohibitive due to its size and subsequent cost. The Brilliant Pebbles concept envisioned smaller, individual space-based interceptors in greater numbers, which would be mass-produced to achieve lower costs.[13]

Following a review of U.S. security requirements upon entering office, President George H.W. Bush supported the continuation of SDI as well as the inclusion of the Brilliant Pebbles concept.

Global Protection Against Limited Strike (GPALS). By late 1989, the strategic relationship between the United States and the Soviet Union was shifting. President Bush initiated a review of SDI, completed in 1990, which noted the chief threat from the Soviet Union during the Cold War was waning, but it also envisioned an increasing threat to U.S. forces from

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[9] President Ronald Reagan, "Address to the Nation on Defense and National Security," Televised Speech, March 23, 1983.
[10] National Security Decision Directive 119. January 6, 1984. SDIO was created on April 24, 1984.
[11] Homing Overlay Experiment: The U.S. Army studied the feasibility of hit-to-kill vehicles, where an interceptor missile would destroy an incoming ballistic missile just by colliding with it head-on. A total of four intercepts were attempted in the test program from 1983-1984.
[12] MDA Historian's Office.
[13] MDA Historian's Office.

short-range ballistic missiles as the capability continued to proliferate to an increasing number of states.[14]

The Persian Gulf War highlighted this threat as Iraq fired ballistic missiles at Israel and Saudi Arabia, killing 28 U.S. soldiers and wounding almost 100 more.[15] Responding to the changing strategic environment, President Bush announced during the State of the Union Address in 1991 that SDI would be refocused. The new system would be known as Global Protection Against Limited Strikes (GPALS), and was to consist of a ground-based national missile defense, a ground-based theater missile defense, and a space-based global defense.

Post-Strategic Defense Initiative – Clinton Administration

Ballistic Missile Defense Organization (BMDO). In 1993 under President Clinton, the Strategic Defense Initiative Organization was renamed the Ballistic Missile Defense Organization. The refocused organization gave priority to the development of theater missile defenses, but continued studies of national missile defenses. However, planned funding for overall missile defenses received a significant reduction.

According to the MDA Historian's Office, "When President Clinton took office, the five-year program for missile defenses called for the expenditure of $39 billion. In about a year, General O'Neill and his staff had to downsize the program and restructure the organization to fit the $18 billion [Bottom-Up Review] program. The task was complicated by further reduction in the program ceiling by another $1.1 billion, leaving the overall missile defense program with about $17 billion [over five years]. This massive transformation was accomplished in a highly effective manner without disrupting the development schedules for vital theater missile defense programs."[16]

Following pressure from Congress in 1996, the new BMDO director, General Lester L. Lyles, began development of a deployment-readiness program. The "three-plus-three" approach was to result in three more years of development of a national missile defense leading to a systems-integration test in 1999. Under the approach, the United States then would be able to field a system in three more years, if needed. Five integrated flight tests were conducted under the BMDO during the Clinton Administration.[17]

National Missile Defense Act of 1999. The growing ballistic missile threat led Congress to a renewed emphasis on national missile defense. In 1998, the Commission to Assess the Ballistic Missile Threat to the United States (also called the Rumsfeld Commission) concluded that "concerted efforts by a number of overtly or potentially hostile nations to acquire ballistic missiles with biological or nuclear payloads pose a growing threat to the United States, its deployed forces and its friends and allies."[18] The Commission's findings were validated when,

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[14] MDA Historian's Office.
[15] U.S. Department of Defense, *Conduct of the Persian Gulf War, Final Report to Congress*, Washington, D.C., April 1992 (available at: http://www.ndu.edu/library/epubs/cpgw.pdf); Frank N. Schubert and Theresa L. Kraus, editors, "The Whirlwind War: the United States Army in Operations Desert Shield and Desert Storm," available at: http://www.army.mil/cmh-pg/books/www/Wwindx.htm.
[16] MDA Historian's Office, "Ballistic Missile Defense: A Brief History."
[17] MDA Historian's Office, "National Missile Defense: An Overview (1993-2000)," available at: http://www.acq.osd.mil/mda/mdalink/html/history.html.
[18] Commission to Assess the Ballistic Missile Threat to the United States (Rumsfeld Commission), Conclusions of the Commission (formed pursuant to Public Law 104-201, and report delivered on July 15, 1998).

in July 1998, Iran conducted the first test of its Shahab-3 medium-range ballistic missile with a range sufficient to strike Israel. The following month, North Korea flight-tested its Taepo Dong-1 missile over the main island of Japan.

In response to the threat, the Senate approved, by a vote of 97-3, the National Missile Defense Act of 1999 in March. The law, signed by President Clinton on July 22, 1999, declares, "It is the policy of the United States to deploy as soon as is technologically possible an effective National Missile Defense system capable of defending the territory of the United States against limited ballistic missile attack (whether accidental, unauthorized, or deliberate) with funding subject to the annual authorization of appropriations and the annual appropriation of funds for National Missile Defense."[19]

Current Bush Administration

Withdrawal from the ABM Treaty. On December 13, 2001, President George W. Bush gave formal notice to Russia that the United States would withdraw from the 1972 ABM Treaty within six months, and it did so on June 13, 2002. The ABM Treaty's termination freed the United States to begin development of a layered missile defense system that the ABM Treaty had prohibited, including the development, testing, and deployment of sea-based, air-based, space-based, and mobile land-based ABM systems, and ABM system components.

Missile Defense Agency (MDA). On January 2, 2002, Defense Secretary Donald Rumsfeld issued guidance on the execution of the U.S. missile defense program. Included were instructions that the Ballistic Missile Defense Organization be renamed the Missile Defense Agency (MDA) to highlight the increased national priority of the agency's mission. The guidance also noted the top four priorities for MDA's mission: to defend the United States, deployed forces, allies and friends from ballistic missile attack; to employ a Ballistic Missile Defense System that layers defenses to intercept missiles in all phases of their flight (i.e. boost, midcourse, and terminal) against all ranges of threats; to enable the fielding of elements of the system as soon as practicable; and to develop and test technologies, use prototypes for early capability if necessary, and improve deployed capability with new technologies.[20]

National Security Presidential Directive (NSPD) 23. NSPD 23, signed on December 16, 2002, stated: "In light of the changed security environment and progress made to date in our development efforts, the United States plans to begin deployment of a set of missile defense capabilities in 2004." It also clarified that the United States will not have a final, fixed missile-defense architecture; instead, defenses will change over time along with the changing threat.[21]

Pursuit of a Layered System. MDA has led a robust effort to develop missile defense systems to target a ballistic missile during all three stages of its flight (boost, midcourse, and terminal). The Ground Based Midcourse Defense System is intended to target a ballistic missile during the midcourse phase. MDA will continue to research and develop defense systems for the other stages of ballistic missile flight including: directed energy systems using high-power lasers such as the Airborne Laser and kinetic energy interceptors (boost phase); the sea-based Aegis Ballistic Missile Defense (also midcourse phase); the Terminal High Altitude Area Defense

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[19] Public Law 106–38 (10 U.S.C. 101 note), Section 2.
[20] Secretary of Defense Donald Rumsfeld, "Missile Defense Program Direction," Memorandum, January 2, 2002.
[21] White House Office of the Press Secretary, "National Policy on Ballistic Missile Defense Fact Sheet," May 20, 2003.

System for the small- and medium-range ballistic missiles, the PATRIOT Advanced Capability-3 (PAC-3), and the Medium Extended Air Defense System (MEADS) (all terminal phase).

Continued Development and Testing

The Bush Administration will continue development and testing of the GMD system and other layers of BMDS.[22] According to MDA, "The need for such testing has not diminished. In this environment, it is prudent and cost effective to combine all relevant development and operational test objectives."[23]

Two recent integrated flight tests (IFTs) of the GMD system did not have 100-percent successful results, but still yielded valuable information.[24] Under IFT-13C, MDA achieved a successful target launch, which allowed the system to collect useful data to improve the system's tracking and targeting. The interceptor did not launch because an automatic "built-in test" did not receive the proper number of health and status messages from the interceptor. The investigation team found that the infrequent communication anomaly would not have jeopardized the success of an interceptor during flight.[25] If such a scenario occurred in a real-life situation, the system would automatically select another interceptor for launch. IFT-14 also resulted in a successful target launch, but the interceptor failed to launch. Ground support equipment is the suspected cause and is under further investigation.[26]

Testing of missile defense system components does not rest solely in integrated flight tests. Numerous other tests are also being conducted on the Ground Based Midcourse Defense system as well as on other components of the layered architecture. The appendix to this paper notes the range of tests that MDA has conducted on the Ballistic Missile Defense System as of March 2005.

Several successful tests of other systems within BMDS should be noted. On November 10, 2004, MDA achieved "First Light" with the Airborne Laser – the first test fire of the system's laser.[27] The Airborne Laser mounts a laser (directed-energy system) aboard a modified Boeing 747 aircraft. Once deployed, the ABL will provide a capability to destroy a hostile ballistic missile soon after it is launched, in the "boost" phase of flight. The system directs a beam of energy to the missile, which will produce a structural failure on the missile's metal skin destroying the missile before it can release its warhead.[28] In December 2004, the

[22] In addition, section 234 of the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005 (P.L. 108-375) requires the Secretary of Defense, in consultation with the Director of Operational Test and Evaluation, to prescribe criteria for operationally realistic testing of fieldable prototypes developed under the ballistic missile defense program and requires a test of the ballistic missile defense system by October 1, 2005, consistent with that criteria.
[23] MDA, "Fiscal Year 05 Budget Estimates," Press Release, February 18, 2004.
[24] Under an integrated flight test (IFT), the interceptor is actually launched as part of the test scenario. Many other tests are conducted that test varying aspects of the system without launching the interceptor. See the attached appendix for examples of other tests.
[25] MDA, "Integrated Flight Test Analysis Completed," Press Release, January 14, 2005.
[26] MDA, "Missile Defense Flight Test Conducted," Press Release, February 14, 2005.
[27] MDA, "Airborne Laser Achieves 'First Light'," Press Release, November 12, 2004.
[28] MDA, "ABL Conducts Extended Flight Test," Press Release, December 10, 2004.

system achieved "First Flight"[29] (the modified Boeing 747 returned to flight following modifications to its airframe that will allow it to be fitted with the laser).

On February 24, 2005, the Aegis Ballistic Missile Defense system had its fifth successful intercept in six tests. The test marked the first use of an operationally configured Standard Missile 3 interceptor – designed to intercept and destroy short- to intermediate-range ballistic missiles.[30] MDA noted, "The interceptor missile tracked successfully to put itself into the path of the incoming target missile, and collided directly with the missile using only the force of the collision to demonstrate "hit to kill" technology"[31] – the same technology used in the GMD system and the Patriot Advanced Capability 3 interceptor missile system.

Key to ensuring the President's vision of a layered missile defense system is the continued research, development, testing, and fielding of boost-, midcourse-, and terminal-phase missile defenses. As Secretary Rumsfeld recently stated, "[The initial capabilities] will evolve over time as technology advances and as we're able to make these limited defenses somewhat more robust. Testing and development will continue to improve the hardware and the software initially deployed in the field, and we'll continue to take advantage of the most promising technologies as they come available."[32]

Conclusion

This initial system is just the first step in a layered defense. The lesson learned is this: The right leadership is crucial – and with true support, American scientists and engineers can surmount technological hurdles that skeptics claim are insurmountable. The system will continue to be tested, refocused, and improved, and – given the changing nature of the security threats this nation faces – that is the most appropriate plan. While this phase is just the beginning, the initial system is a remarkable capability – one that the United States has sought since the V-2 first terrorized the Allies in the Second World War.

[29] MDA, "Airborne Laser Returns to Flight," Press Release, December 3, 2004.
[30] MDA, "Aegis Ballistic Missile Defense Flight Test Successful," Press Release, February 24, 2005.
[31] MDA, "Aegis Ballistic Missile Defense Flight Test Successful."
[32] Secretary Donald Rumsfeld, "Remarks at the Seventh Annual Space and Missile Defense Conference," Huntsville, Alabama, August 18, 2004.

Appendix: BMDS Test List (Updated March 2005)

Test Name	Test Date	Significant Accomplishments
ABL		
Initial Flight Test Series	7/16-12/19/04	Initial flight test series of 14 flight tests totaling 66.3 flight hours. Verified functionality of unmodified aircraft systems and partial verification of initial aircraft modifications to include performance of the BMC4I. Air refueling capability demonstrated as well as the Infrared Search and Track to develop a target track during IFT-10.
Return to Flight with Operational Main Turret	12/3/04	Successfully executed 11 flights to verify the proper operation of the modified aircraft. These were the first flights with the operational flight turret installed, but in the protected, stowed position. Internally, the major optical benches -Beam Transfer Assembly and Multi Beam Illuminator – were installed prior to the initiation of these flights.
First Light of High Energy Laser	11/10/04	High Energy Laser light was first generated with the integrated 6 flight modules of the High Energy, Chemical Oxygen Iodine Laser (COIL).
		ABL High Energy Laser Testing
SYSTEM INTEGRATION LABORATORY-Checkout A: Basic Hydrogen Peroxide Loop Checkout with H2O	1/16/04	Verified integrity of Basic Hydrogen Peroxide loops and low-speed turbo-pump operations.
SYSTEM INTEGRATION LABORATORY-Checkout B: Basic Hydrogen Peroxide Loop Conditioning	03/19/04	Verified heat exchanger performance and H_2O_2 decomposition rates.
SYSTEM INTEGRATION LABORATORY-Checkout D	4/17/04	Verified Thermal Management Subsystem performance and pressure recovery system manifold pressures.
SYSTEM INTEGRATION LABORATORY-01: 70% H2O2 Conditioning	04/26/04	Verified H_2O_2 decomposition rates and cleanliness in ejector loop.

Test Name	Test Date	Significant Accomplishments
SYSTEM INTEGRATION LABORATORY-02M: Pressure Recovery System Ejector Testing	05/23/04	Verified Gas Generator operations and successful ejector operations.
Optics & Diagnostics Subsystem Lab Testing	06/18/04	Verified Optics and Diagnostic Subsystem performance in quiescent lab environment.
SYSTEM INTEGRATION LABORATORY-Checkout K: OPTICS AND DIAGNOSTIC SUBSYSTEM Checkout	06/30/04	Verified Optics and Diagnostic Subsystem Control loops and bench alignment on ground.
SYSTEM INTEGRATION LABORATORY-04: Basic Hydrogen Peroxide High Speed Ops	07/28/04	Verified High Speed turbo pump operations with Basic Hydrogen Peroxide.
SYSTEM INTEGRATION LABORATORY-06: Iodine flows	Ongoing	Verify Iodine system flows
First Light of High Energy Laser	11/10/04	High Energy Laser light was first generated with the integrated 6 flight modules of the High Energy, Chemical Oxygen Iodine Laser (COIL).
SYSTEM INTEGRATION LABORATORY-09M: OPTICS AND DIAGNOSTIC SUBSYSTEM, Hardware Abort System and Iodine Characterization	11/10/04 – 1/21/05	Including the First Light Event, this test series included 7 lasing intervals for a cumulative time of about 2.5 seconds. This test series allowed adjustments to operating parameters of the Optical Diagnostic System, the Hardware Abort System, and the Chlorine and Iodine flow rates.

Test Name	Test Date	Significant Accomplishments
SYSTEM INTEGRATION LABORATORY-10M: Altitude, OPTICS AND DIAGNOSTIC SUBSYSTEM, Hardware Abort System, Performance	Test Series Started 3/2/05	This series of tests will continue to refine the operation of the High Energy COIL while extending the continuous laser time to about 3 seconds. The first test phase of this series was limited to the characterization of the operation of the Pressure Recovery System at the minimum design altitude of 38,500 feet. Follow on phases will result in longer laser times.
		ABL Beam Control/Fire Control Testing (BC/FC)
Surrogate Turret Tests	12/19/02	Surrogate Turret installed on A/C and supported 14 flight tests to verify basic roll/yaw functionality and aerodynamic performance.
Beam Transfer Assembly (BTA) Functional Tests	9/12/03	Steering mirrors, deformable mirrors and sensors integrated along with software to demonstrate pointing, jitter, and atmospheric compensation functionality (101 of 101 planned test points completed).
Multi-Beacon Illuminator (MBIL) Functional Tests	3/26/04	High Power Track Illuminator Laser (TILL) and Beacon Illuminator Laser (BILL) successfully integrated, aligned, and fired (78 of 78 planned test points completed).
MBIL-to-BTA Inter-Bench Control Functional Tests	4/15/04	Active alignment control between BTA and MBIL bench verified and TILL and BILL lasers propagated from MBIL to BTA bench (47 of 47 planned test points completed; 4 w/ surrogate illuminators).
BC/FC End-to-End Performance Tests	4/19/04	End-to-End functionality including jitter control, atmospheric compensation, and target pointing verified (167 of 174 planned test points completed; 2 deferred to Flight Turret tests and 5 deferred to System test).
Flight Turret Testing	9/28/04	Flight Turret (Ball and Roll Shell) integrated and 25 functional and performance tests conducted to verify operational capability.
Safety of Flight and Flight Performance Envelope Expansion	12/3/04–3/1/04	Successfully executed 11 flights to verify the proper operation of the modified aircraft. These were the first flights with the operational flight turret installed, but in the protected, stowed position. Internally, the major optical benches -Beam Transfer Assembly and Multi Beam Illuminator – were installed prior to the initiation of these flights.
Low Power Beam Control / Fire Control Flights	Started 3/2/05	The first flight to verify and characterize the operation of the BC/FC in a flight environment. The major milestone of the first flight was the activation and operation of the active mechanical support system used to isolate the optical benches (Beam Transfer Assembly and Multi Beam Illuminator) from the vibration and motion of the airframe.
		ABL Battle Management Command/Control/Communications/Computers/Intelligence (BMC4I) Testing.

Test Name	Test Date	Significant Accomplishments
ARS Pod/Pylon Tap Test	Mar. 03	Performed tap test on the ARS Pod/Pylon to determine resonant frequencies.
BMC4I ARS Integration Test	Dec. 03	Evaluated interface between BMC4I software and ARS. Investigated ability for BMC4I to command ARS and communication between the two.
ARS Vibration Testing	Feb. 04	Evaluated High Powered Laser (HPL) and Reference Laser (RL) shock isolators against the revised PIDs environments.
AFSIT Link-16 compliance Phase 1	3/25/04	Tested correctness of ABL's Link-16 implementation to date. Total of 33 anomalies were recorded - 13 due to Test Script Errors, 6 due to Processing Errors, and 1 due to combination of Test Script and Processing Errors, 9 due to a combination of Processing and Display Errors, 3 due to Display Errors, and 1 due to a combination of Requirements and Display Processing Errors.
Tower Test	May 04	Evaluated FLIR and Tracker performance against aircraft at Orlando International Airport and captured planetary data for Stellar alignment; Sun, Moon, Mercury, and Venus.
Reference Laser Vibration Test	May 04	Evaluated candidate isolators (AM002-11 & AM002-14) through subsystem RL vibration tests.
ARS LOS Jitter Vibration Test	Jun. 04	Evaluated FLIR jitter/LOS stabilization (lateral axis only). Requires follow-on testing.
AFSIT Link-16 compliance Phase 2	9/15/04	Evaluated correctness of ABL's Link-16 implementation to date. Previous anomalies fixed. Awaiting final report from AFSIT.
Link-16 ABL/AEGIS Integration Test Phase 1	6/15/04	Successfully connected, transmitted, and received messages from ABL Virtual Aircraft Facility to SPAWARSYSCEN (the AEGIS BMD lab).
		ABL Target and Diagnostic Testing.
Lance Missile – BMC4I Test	9/4/02	Successful Lance launch to support ABL, BMC4I flight tests.
Proteus Ground Tests	1/30/03	End-to-end testing of Proteus Target Board subsystems including telemetry, user interface, and limited detector subset (ground test).
Proteus Flight Tests	1/31/03	Deployment verified onboard data-acquisition system and telemetry downlink, and electromagnetic interference characteristics (air test).
MARTI body-drop test	6/6/03	Tested command and control uplink/downlink.
Angle Determination System	3/15/04	Initial Testing of RAD system instrumentation used for correct alignment of Target Board. Proteus Pilots able to control aircraft within reason.

Test Name	Test Date	Significant Accomplishments
Proteus Flight Tests	4/19-22/04	Demonstrated sensor operation, relative attitude display (device for maintaining proper orientation to ABL), and collected Plume Emulator IR data.
MARTI Pathfinder Flight Test	7/15/04	Demonstrated the ability to forecast balloon flight path trajectories, and measure the accuracy of the forecast and our ability to work simulated drops within limited predictive avoidance windows.
Aegis BMD		
Aegis: FTR-1A	1/25/01	Successfully demonstrated SM-3 third-stage, two-pulse TSRM operation and nosecone ejection through separation of an inert KW, against a live target.
DACS DU-3	2/3/01	Developmental ground test. No structural issues during firing. Main Thrust Assembly (MTA) met all requirements. Attitude Control Assembly (ACA) did not meet switching requirements.
Aegis : CMP – 3B	2/21/01	Collected data on a threat representative, separating target, using the Aegis BMD sensors. IR near- and far-field data was collected as well as synthetic wideband AN/SPY-1 data.
Aegis: Quick Reaction Launch Vehicle – 1	3/22/01	Successfully demonstrated radar acquisition of a non-separating (Group A) target with a threat representative trajectory and exo-atmospheric target pointing performance.
Aegis: Terrier Lynx - 2	9/27/01	Successful target missile qualification test.
Aegis: FM-2	01/25/02	Primary objective of FM-2 test was to evaluate SM-3 fourth stage Kinetic Warhead (KW) guidance, navigation and control. All mission primary and secondary objectives were achieved. Mission also included first fully operational Standard Missile System Integration Laboratory (SM)-3 with live Solid Divert and Attitude Control System (SDACS) to steer the KW into the target. SM-3's KW aimed at a target achieved direct hit exceeding objectives for this event.
DACS DU-4	2/26/02	Developmental ground test firing. ACA switching issues corrected during pulse 1, but structural failure occurred during pulse 2. Corrections made prior to DU-5.
Aegis: SIT 2	Mar. – May 02	Demonstrated the transmission, reception, and display of near real-time BMD data.
DACS MEE-1	3/13/02	Developmental ground test firing. ACA switching problems and cracked diverter balls observed. Corrections made to the valve design prior to successful MEE-2.
ALI 2.0 EA	3/14/02	The ALI 2.0 Computer Program EA was successful. It validated the computer program in preparation for FM-4.
Aegis: DHT-2	3/27/02	The DHT series sled tests demonstrated SM-3 KW performance against high explosive, chemical submunition, bulk chemical, and nuclear payloads at conservative impact velocities.

Test Name	Test Date	Significant Accomplishments
Aegis: QRLV-2	4/22/02	Demonstrated the Group A target with off-nominal exo-atmospheric body dynamics. Additionally, AWS tracking performance to support an ascent phase intercept was demonstrated. Data was also collected to assess radar face transitions.
DACS MEE-2	6/11/02	Successful ground test firing. ACA valve met all requirements.
FM-3	06/13/02	Successfully demonstrated Aegis Lightweight Exo-Atmospheric Projectile (LEAP) Interceptor (ALI) system capability to hit ballistic missile target in exo-atmosphere.
Aegis: PAC Blitz 02	7/2/02	USS LAKE ERIE (CG 70), the BMD CG, collected radar data on a Terrier Lynx target, including RV separation, and successfully completed an array face transition using the LINEBACKER computer program. Also, an interoperability focus was to exercise Link-16 data update requests with resultant covariance messages that would be required for Aegis BMD to participate in the GMD Integrated Flight Tests (IFT).
Aegis: DHT-4	8/8/02	The DHT series sled tests demonstrated SM-3 KW performance against high explosive, chemical submunition, bulk chemical, and nuclear payloads at conservative impact velocities.
TSRM DVT-1	8/23/02	Structural failure of nozzle flex seal after start of Pulse 2 burn. Nozzle subsequently redesigned.
DACS DU-5	9/13/02	Successful ground test firing. Components met all objectives. Satisfied requirements to validate DACS design.
DACS MMEE-1	11/6/02	Developmental ground test firing. All requirements met through Sustain and Pulse 1 modes. Pulse 2 switching did not meet requirements. Changes to the valve design were made to correct the problem.
FM-4	11/21/02	Successfully demonstrated Aegis BMD system capability to intercept ballistic missile target in ascent phase of flight.
DACS MDU-1	12/18/02	Developmental ground test firing. MTA and ACA both encountered switching problems and leaks. Changes to the valve design were made to correct the problems.
DACS Mono DU-2	2/26/03	Developmental ground test firing. Missed switching observed in MTA during Pulse 1 and 2. Post-test cracks observed. Changes to the valve design were made to correct the problem.
ALI 2.2 EA	4/10/03	The ALI 2.2 Computer Program EA was successful. It validated the computer program and its interfaces in preparation for further ALI flight tests.
Wind Tunnel Test of Japanese Design nose cone	5/9/03	NASA-conducted test verified and validated thermal modules of the Japanese nosecone under simulated flight environments.
Monolithic DACS Qualification Test –1 (MQUAL-1)	5/29/03	Flight weight, monolithic DACS static firing with environmental modifications applied prior to test firing. This same DACS configuration was used in FM-5.

Test Name	Test Date	Significant Accomplishments
FM-5	6/18/03	Unsuccessful intercept. ALI 2.2 computer program, ascent phase intercept attempt of a non-separating, short-range target. Successful mission until after Kinetic warhead eject from Third stage rocket motor. Comprehensive DACS redesign effort initiated to correct problem. Created DACS Project Officer position to lead effort. Effort is ongoing. First attempt at establishing target track based on off-board sensor cue. First flight of monolithic SDACS and use of SDACS sustain and Pulse 1 capability. First attempt to have KW actively guide to/impact target at nosecone.
Surv 1.2 EA	9/23/03	The Surv 1.2 Computer Program EA was successful. It validated the Surv 1.2 computer program for follow-on ICBM surveillance and tracking tests.
ALI 2.2.2 EA	10/14/03	The ALI 2.2.2 Computer Program EA was successful. It validated the computer program and its interfaces for follow-on SM-3 engagement missions.
FM-6	12/11/03	First successful attempt to have KW actively guide to/ impact target at nosecone. First successful flight of monolithic SDACS and use of SDACS sustain capability.
Ground Testing and calibration of 2-color QWIP sensor	12/18/03	Successfully completed calibration of both QWIP IR sensors. Sensors will be used for captive carry tracking missions.
TSRM DVT-2	4/21/04	Over-pressurization of motor occurred during Pulse 1. Cause determined to be processing error. Corrections to be tested in DVT-3 (2QFY05).
Aegis: PAC Explorer III	16-18 Jul. 04	A Long Range Surveillance and Track training and test event during the multi-national RIMPAC exercise. - One Aegis Readiness Assessment Vehicle (ARAV-ER) launch - Testing for BMDS, STADIL J, IDO voice and data architectures, and CONOPS - Concurrent AAW scenarios and simulated land attack scenarios
Aerojet DACs	7/28/04	Successful ground test firing. Objectives were met to validate and demonstrate TDACS design.
3.0E EA	8/27/04	The Aegis BMD Block 04 3.0E Long Range Surveillance and Track (LRS&T) Computer Program EA was successfully conducted.
Aegis: PAC Explorer IV	9/17-29/04	Demonstrated the Aegis BMD role in BMDS Mid-Course Engagement Sequence using 3.0E and CDLMS 3.3 Computer Programs. Also maintained STADIL J network. All objectives were met.

Test Name	Test Date	Significant Accomplishments
FTM 04-1	2/24/05	STANDARD Missile 3 (SM-3) launched from Aegis Cruiser successfully intercepted ballistic missile target replicating short-range ballistic threat. Mission was first use of Aegis Ballistic Missile Defense (BMD) 3.0 system and SM-3 Block 1 Missile. Mission successfully demonstrated effectiveness of Aegis sensors, weapons, and engagement control. FTM 04-1 incorporated significant operational realism through the use of operational ships and crews, an unscripted scenario, a no-notice target launch, and a minimally constrained operational patrol area for the ship. FTM 04-1 was part of the Stellar Dragon Campaign, which included TRACKEX and At Sea Demo (ASD), during which Aegis BMD 3.0 system was tested in a multi-warfare environment that included ballistic missile attack scenarios simultaneous with cruise missile, small boat, and submarine attack scenarios.
Arrow		
Arrow/Caravan: AST-5	9/14/00	Successful intercept against a Black Sparrow Target. Demonstrated flight test performance, Sensor Operations, and Battle Management Control.
Arrow/Caravan: AST-6	8/27/01	Successful intercept against a Black Sparrow Target. Demonstrated flight test performance, Sensor Operations, and Battle Management Control.
Arrow/Caravan: AST-8	1/05/03	Successful fly-out demonstration of a multiple interceptor launch capability. Included successful mission planning by Battle Management Control and launch of one fully operational test interceptor and three short burn duration test missiles.
Arrow/Caravan: AST-9	12/16/03	Successful intercept against a Black Sparrow Target. Demonstrated flight test performance, Sensor Operations, and Battle Management Control.
Arrow/Caravan: USFT-1	7/28/04	Successful Arrow Weapon System intercept of non-separating Liquid Fueled Threat Systems representative of threats to Israel. Demonstrated flight test performance, Sensor Operations, and Battle Management Control. Test conducted at Pt. Mugu, CA.
Arrow/Caravan: USFT-2	8/26/04	Partially successful test of Arrow Weapon System against a separating Short Range Air Launched Target representative of expected threats to Israel. No intercept due to missile component failure. Demonstrated sensor operations and Battle Management Control including discrimination capability against multiple objects. Test conducted at Pt. Mugu, CA
BMDS		
GT-185	6/09/04	Conducted BMDS System level testing using an Air Force target of opportunity to exercise the BMDS communications architecture. Aegis, GMD, and C2BMC elements participated.

Test Name	Test Date	Significant Accomplishments
MDIE 04a (System Level hardware in the loop ground test)	2/23/04-3/12/04	Verification of System Capability Specification functions. Tested BMDS elements on 14 SCS functions First time test of message exchange with: • C2BMC and Simulated/HWIL Element representations ▪ TADIL-J input to C2BMC ▪ GMD interoperable with PAC, JTAGS ▪ JTAGS cueing C2BMC
MDIE 04b (System Level hardware in the loop ground test)	9/20/04-1/10/04	Verification of System Capability Specification functions. Tested BMDS elements on 32 SCS functions • Tested LDO versions of C2BMC (4.3.5), GFC (4A.2.3), ESI (4.2.1), SBIRS (71.02.03 STNL), JTAGS (12.4.6), Aegis BMD (3.0E) for message transfer • The test represented ESG Events and Messages for complete set of ESGs
C2BMC		
Spiral 4.1 Infrastructure	9/18/03	Successful Spiral 4.1 Software, Cycle 3 integration and interoperability test with other BMDS Elements, for basic infrastructure functions and exchanges.
C2BMC: Spiral 4.2 Planning	1/25/04	Successful Spiral 4.2 Software, Cycle 3 integration and interoperability test with other BMDS elements, in pre-Missile Defense Integration Exercise MDIE test event as well as participation in FM 6 Test.
C2BMC: Spiral 4.3 Situational Awareness	7/27/04	Successful Spiral 4.3 Software, Cycle 3 integration and COCOM communications interoperability test with other BMDS Elements in Pre-Missile Defense Integration Exercise MDIE test event. Participated in Glory Trip-185, PACEX III, SICO 6A, IGT-4, and USFT-2. Successful integration of communications with COCOM, C2BMC Suites and BMDS Elements.
FBX-T		
Forward Based Radar (FBX-T) Testbed GT-185	6/9/04	Risk reduction test of forward based radar algorithms in the test bed against AF target of opportunity. Collected data to support FBX-T Testbed feature algorithm development. Operational message set successfully communicated to C2BMC. First Demonstration of Aegis BMD in-line.
Forward Based Radar (FBX-T) Testbed GT-184	7/23/04	Risk reduction test of forward based radar algorithms in the test bed against AF target of opportunity. Collected data to support FBX-T Testbed feature algorithm development
Forward Based Radar (FBX-T) Testbed Arrow Caravan USFT 2	8/26/04	Observed the target launched for Arrow test. Test bed collected data to support FBX-T Testbed risk reduction. Successfully exercised wide-band, split-track, and self-cued search capabilities. Two new “B” series messages tested/communicated to/from C2BMC.

Test Name	Test Date	Significant Accomplishments
GMD		
IFT-6	7/14/01	Successful intercept. Demonstrated integrated system performance, EKV flight test performance and sensor operations including discrimination.
IFT-7	12/03/01	Successful intercept. Demonstrated integrated system performance including EKV flight test performance and discrimination, sensor operations, and BMC3 operations using improved software. Integrated and tested satellite based launch detection data fusion (out-of-line) into the Space Based Infrared System (SBIRS) Mission Control Station in preparation for IFT-8.
IFT-8	03/15/02	Successful intercept of more complex target requiring greater level of discrimination. Demonstrated integrated system performance including EKV flight test performance and discrimination, sensor operations, and BMC3 operations using improved software. Demonstrated in-line satellite based launch detection data fusion (out-of-line) into the SBIRS Mission Control Station. Demonstrated: ▪ Integration of Systems Elements and Functionality ▪ Sensor Operations ▪ GFC/C Operations ▪ EKV Flight Test Performance ▪ Successful intercept ▪ Successful System Test
GT-178 Target of Opportunity	4/8/02	GMD component test. GBR-P radar successfully collected data on Air Force Target to test engineering software upgrades.
GT-179 Target of Opportunity	7/7/02	GMD system test against Air Force target to reduce the technical risks in GMD IFT-9.
GT-180 Target of Opportunity	9/20/02	GMD System test against Air Force target to reduce the technical risks in future GMD Integrated Flight Tests.
IFT-9	10/14/02	Successful intercept against new complex Target. Demonstrated EKV Flight Test Performance, Sensor Operations, BMC3 Operations. Integrated Other Elements (e.g., Aegis). Demonstrated: ▪ Integration of Systems Elements and Functionality ▪ Sensor Operations ▪ Fire Control and Communication Operations ▪ EKV Flight Test Performance ▪ Successful intercept ▪ Successful System Test

Test Name	Test Date	Significant Accomplishments
IFT-10	12/11/02	Successful integrated system test up to EKV separation. Unsuccessful intercept due to no separation of EKV from booster. Demonstrated: ▪ Integration of Systems Elements and Functionality ▪ Sensor Operations ▪ Fire Control and Communication Operations ▪ EKV Flight Test Performance - Unsuccessful intercept due to no separation of booster/interceptor (Not Related to IFT-5 Failure) • Successful Integrated System Test up to Separation
Taurus Lite	Feb. 03	Risk reduction pathfinder flight demonstration of near-IDC configured OBV booster. Demonstrated ability to assemble and integrate OBV-like booster within GMD test infrastructure. Demonstrated flight performance of IDC-configured booster propulsion components and interfaces using payload emulator.
BV-6	8/16/03	Risk reduction flight of the IDC-configured OBV prior to IFT-13B. Demonstrated successful 3-Stage booster fly-out. Verified OBV design, integration processes, and flight performance. Validated Command Launch Equipment performance for OBV configuration and booster vehicle guidance/control. Collected data on EKV payload adaptor interface and environment.
BV-5	Jan. 04	First flight of BV+ alternate booster with emulated EKV. Demonstrated 3-Stage booster fly-out. Validated Command Launch Equipment performance for BV+ configuration and booster vehicle guidance/control.
IFT-13B	1/26/04	Demonstrated: ▪ Successful booster fly-out and payload separation of IDC-configured OBV with high fidelity EKV emulator. Evaluated the response to weapons tasking and flight guidance. First time participation of SBIRS Test Node. First participation of CMOC personnel. ▪ First integrated flight test using the Orbital Sciences Corporation boost vehicle of the GMD Element ▪ First integrated flight test involving participation by Warfighters, with Operational Test Agency participation ▪ Simulated and actual end-to-end component functional performance of the integrated GMD Element ▪ Integration of System Elements & Functionality ▪ Sensor Operations ▪ GFC/C Operations

Test Name	Test Date	Significant Accomplishments
IFT-13c	12/15/04	New capabilities tested: ▪ Strategic Target System (STARS-1) Target Launch Vehicle ▪ Generic Rest of World (GROW) Target Reentry Vehicle (RV) + target dynamics ▪ Kodiak Launch Complex for target launch ▪ Simulated Cobra Dane Upgrade (CDU) radar operations ▪ Target RV not discriminated before interceptor launch ▪ Integration of System Elements & Functionality ▪ Demonstrated Sensor Operations ▪ Demonstrated Fire Control and Communication Operations Capabilities Not Demonstrated: ▪ Did not demonstrate first planned flight of Limited Defensive Capability Ground Based Interceptor (GBI) design. Launch abort commanded as a result of Interceptor Built in Test Failure. Failure root cause determined and fixed with Flight Computer software change.
IFT-14 (IFT-13C Repeat Test)	2/13/05	Capabilities tested: ▪ Successful Strategic Target System (STARS-1) Target Launch ▪ Successful employment of Generic Rest of World (GROW) Target Reentry Vehicle (RV) + target dynamics ▪ Successful Kodiak Launch Complex target launch operations ▪ Simulated Cobra Dane Upgrade (CDU) radar operations ▪ Integration of System Elements & Functionality ▪ Demonstrated Sensor Operations ▪ Demonstrated Fire Control and Communication Operations Capabilities Not Demonstrated: ▪ Did not demonstrate planned flight of Limited Defensive Capability Ground Based Interceptor (GBI) design and intercept of target reentry vehicle. Interceptor launch abort commanded as a result of launch Silo support equipment failure. Root cause analysis on-going.
Integrated Ground Test (IGT-2)	7/19/04 – 7/31/04	Demonstrated BMDS functionality to transition to alert, acquire and track threat objects, passing of object tracks to Battle Manager and Battle Manager correlation and fusion of sensor tracks to create system track. First IGT to: ▪ Test Cobra Dane Upgraded Radar ▪ Use STN-Lab ▪ Demonstrate LDO focused IGT ▪ Test Aegis (MEDUSA) as risk mitigation for IGT-4

Test Name	Test Date	Significant Accomplishments
System Integration and Check-Out (SICO-1) – ground test	12/08/03 12/9/03-12/11/03	Successful Integration Check Out of LDO / IDC distributed network and equipment at JNIC, STN, and the ESI-DB at SPAWAR-San Diego. Multiple IDO / LDO scenarios exercised end-to-end with actual equipment at deployed sites. Pre-IDC configurations used. All items rechecked in updated configurations at each subsequent SICO event.
SICO-3: System Integration and Check-out. Ground Test Demonstration	4/09/04 3/29/04-4/5/04	Successful Integration Check Out of LDO / IDC distributed network and equipment at Fort Greely, Alaska. Included the GFC/C, CLE, CLE Lab, System Integration Laboratory Interface Vaults and GBI Electrical Check Out System in the vaults. Also included the In-Flight Interceptor Communication System Data Terminal at Fort Greely. Rechecked JNIC, STN, and ESI-DB SD.
SICO-5: System Integration and Check-out. Ground Test Demonstration	7/29/04 7/19/04-7/29/04	Successful Integration Check Out of LDO / IDC distributed network and equipment at Shemya Island, Alaska. Included Cobra Dane Radar Upgrade and the In-Flight Interceptor Communication System Data Terminal at Shemya. Rechecked Fort Greely equipment and JNIC, STN, and ESI-DB SD. Scenarios included use of both Shemya and Fort Greely IDTs against a single threat trajectory.
SICO-6a: System Integration and Check-out. Ground Test Demonstration	9/25/04 9/20/04-9/28/04	Successful Integration Check Out of LDO / IDC distributed network and equipment with an Aegis BMD 3.0E ship dockside in Japan. Also included At-Sea exercises with the ship underway. Rechecked Cobra Dane Radar Upgrade and In-Flight Interceptor Communication System Data Terminal at Shemya. Rechecked latest upgrades to the Fort Greely and JNIC equipment. STN converted to ISMDC. Additional ESI-DB at JNIC and Fort Greely. Scenarios included use of both Aegis and Shemya radars with Fort Greely GBIs against single and multiple threat trajectories.
Integrated Ground Test (IGT-4A)	9/23/04-9/27/04	Demonstrate the GMD capability to perform the launch and engage on Aegis Engagement Sequence Group.
Integrated Ground Test (IGT-4b)	10/18-19/04	First IGT to: – Use Operational Aegis tapes produced by the Deployable SW – Test C2BMC – Optimize Aegis Ship location for multiple aim points – Utilize Shemya, AK & Houston, TX Aim Points – Test the specific threat
PAC-3		
DT-1	9/29/97	Control Test Missile (CTM) flight vs. software-generated target: Successfully launched the PAC-3 missile to collect data to verify missile launch functions and interfaces, missile flight functions, and missile operation in a flight environment.

Test Name	Test Date	Significant Accomplishments
DT-2	12/15/97	PAC-3 CTM flight vs. software-generated target: Successfully launched the PAC-3 missile to collect data to demonstrate missile/system integration prior to launch and communication between ground system and missile in flight, and to evaluate missile performance responses during a long range/low altitude flight trajectory.
Seeker Characterization Flight (SCF)	3/15/99	PAC-3 Guided Test Missile (GTM) vs. Hera Ballistic Reentry Vehicle (BRV) representing a Tactical Ballistic Missile (TBM)–Reentry Vehicle (RV): Target was successfully engaged and destroyed by body-to-body impact.
DT-3	9/16/99	PAC-3 GTM vs. Hera BRV [TBM-RV]: Target was successfully engaged and destroyed by body-to-body impact.
DT-5	2/5/00	PAC-3 GTM vs. Hera Modified BRV (MBRV)-3 [TBM–Full Body (FB)] : Target was successfully engaged and destroyed by body-to-body impact.
DT-6	10/14/00	DT-6a: PAC-3 vs. Storm Maneuvering Tactical Target Vehicle (MTTV) [TBM-RV]: Successfully engaged and destroyed a Storm target carrying submunitions using a cold-conditioned PAC-3 missile while the system simultaneously engaged and killed a cruise missile surrogate target.
DT-8	3/31/01	Successfully engaged a TBM performing a helix maneuver with PAC-3 missile ripple fire. Successfully intercepted with the first missile and command destructed the second missile of the ripple.
DT-9	7/9/01	Successfully engaged a TBM and an ABT simultaneously in an ECM environment. The system properly performed all functions to allow the missile to acquire the target and enter homing, but an onboard missile anomaly caused the missile to miss the TBM target. (Engagement of QF-4 aircraft was successful).
OT-1	3/21/02	TBM with helix maneuver, greater than 20km remote launch: Successfully destroyed the TBM with the first interceptor. Second interceptor failed to launch due to a generator shutdown.
OT-4	4/25/02	Simultaneous Engagement of two TBMs: successfully intercepted only one TBM due to Launch Sequence Failure (LSF) on one of two available missiles
OT-2	5/30/02	PAC-3 missile ripple fire versus Hera low RCS / high velocity target: Successfully intercepted with the first missile, the second missile experienced a LSF and did not launch.
ATM 2-1	3/4/04	Successful ripple fire engagement of threat representative TBM.
DT/OT-11	9/2/04	Successful simultaneous engagement of a TBM and CM with three Cost Reduction Initiative (CRI) PAC-3 missiles.
DT/OT-12	11/18/04	Successful ripple fire engagements of two simultaneously arriving TBMs with CRI and baseline PAC-3 missiles.

Test Name	Test Date	Significant Accomplishments
STSS		
Six Critical System Performance Capability Tests	Sep. 02	Verified that component/subsystem meets performance requirements.
Satellite 1 Hardware Reactivation	Nov. 03	Verified that component/subsystem meets performance requirements.
Satellite 2 Hardware Reactivation	Mar. 04	Verified that component/subsystem meets performance requirements.
Satellite 1 Spacecraft Integration and Test Complete	Aug. 04	Verified that component/subsystem meets performance requirements.
Satellite 1 Track Sensor Testing	Jan. 05	Verified that component/subsystem meets performance requirements.
Satellite 1 Acquisition Testing	Mar. 05	Verified that component/subsystem meets performance requirements.
Satellite 2 Spacecraft Integration and Test	Apr. 05	Planned
Satellite 1 Sensor Payload Integration and Test	May 05	Planned
Satellite 2 Track Sensor Testing	Jun. 05	Planned
Satellite 2 Acquisition Testing	Feb. 05	Verified that component/subsystem meets performance requirements.
Satellite 2 Sensor Payload Integration and Test	Sep. 05	Planned
THAAD		

Test Name	Test Date	Significant Accomplishments
THAAD: DDV-3 Static Motor Test	Sep. 02	A THAAD boost motor was successfully static fired Sep. 02. This firing achieved numerous firsts in the development of the THAAD solid propellant boost motor, including demonstration of an innovative lightweight, consumable igniter; successful test firing of a new nozzle design; and demonstration of improved production manufacturing processes and tooling designed to significantly reduce cycle time for case liner installation, solid propellant cast and solid propellant machining operations. This firing also was the first test of the Thrust Vector Control operational profile planned for the flight test program. This profile included “nozzle dither” designed to ensure that nozzle torque remains within system performance requirements. The success of this test is a significant step towards a highly successfully first flight.
DDV-4 Static Motor Test	Jan. 03	A THAAD Development Block 4 solid-propellant boost motor (DDV-4) was successfully static fired Jan. 03. This test was a significant step in the maturation of boost motor design in preparation for THAAD flight testing. The firing was designed to reduce risk to the flight test program by demonstrating performance of new key design features of the boost motor’s insulation, igniter and nozzle. In addition, DDV-4 was the second firing to demonstrate improved manufacturing processes and tooling that significantly reduce production cycle times. Test data indicates that the boost motor performed as expected.
IMU CQT-1 Test	Nov. 04	IMU Component Qualification Testing was successfully completed Nov. 04.
IMU Brassboard Pre-Qual Test	Mar. 04	IMU Pre-Qualification Testing was successfully completed in mid-Mar. 04 as a pathfinder for formal qualification currently underway.
HEMTT Variant Qual Test	Apr. 03	Successfully passed all phases of qualification tests to include 2,000 mile mobility/endurance tests, shock and vibration testing, temperature, and vehicle stability. As a result, 35 vehicle modifications have been integrated.
Missile Separation Tests	09/17/03	Demonstrated the ability of the missile to separate from the booster motor and deploy the aerodynamic shroud in flight using explosive charges. Validated shock environments generated by separation events. Demonstrated performance and survival of critical flight instruments, retiring a significant program risk.
DACS ACS/DCS Thruster Qual Test	Apr 03 – Jan 04	DACS Thruster Qualification Testing was successfully completed and led to two successful DACS system level flight confidence tests in July and Aug. 04.
Laser Initiated Ordnance System Qual Test	Sep. 04 –Apr. 05	LIOS related assembly qualification testing is currently underway. Hardware was available for testing in Sep. 04 and testing began at that time. Expected completion date is Mar. 05 and is required to support first flight.

Test Name	Test Date	Significant Accomplishments
Environments Test Phase 1	Dec. 04-Apr. 05	Environments Test Phase I started in December 2004 with the Transportation Environments Test to collect environments data to support ground transport of WSMR flight test vehicles. Currently working though retrofits and tests for Pre-flight Temperature Rise, Canister Separation Shock, Altitude, Boost Flight Vibration, KV/Booster Separation Shock, and Shroud Sep Shock. The Phase I test is required to verify the first THAAD flight missile will operate after exposure to ground transportation and handling environments and during exposure to missile flight environments.
E3 Test Phase 1	Feb. – Apr. 05	This phase of E3 testing started in February 2005 and is currently underway with KV Electromagnetic Radiation Operating (EMRO) environments testing. A missile in-flight configuration (KV with Booster) follows on-going KV testing. This phase is required to verify the first THAAD flight missile will operate in the expected electromagnetic environment.
THAAD: Booster Static Firing	8/24/04	Successful Booster motor firing of first Aerojet Cast/CSD finished Booster motor. Aerojet recently joined the THAAD team to transition motor operation from CSD after they announced their exit from their San Jose facility. The successful test indicates an orderly transition from CSD to Aerojet is in progress.
Target of Opportunity	9/02/04	THAAD Radar acquired and tracked the low endo-atmospheric ballistic missile from the Patriot PAC-3 DT/OT-11 Mission at WSMR. Using production HW and SW, the radar classified the object as a threatening TBM, tracked the object to intercept and gathered hit assessment data.
Captive Carry Test	9/20/04	Verified the critical Radar-to-Missile communication link for initial tracking, in-flight target updates, and “target object direction”. This was a risk mitigation test for the first flight planned for 2QFY05, and was conducted using representative missile Communication Transponder (CT) /Antennas mounted on an airplane.
THAAD: Booster FCT	9/28/04	The second static-firing of a FT-01 like solid rocket motor and Thrust Vector Assembly (TVA) was conducted by Aerojet at the Chemical Systems Division facility, on 28 September 2004 and was successful. The data shows a good match of actual pressure over predicted. TVA performance was good. This was the second of two flight confidence tests required to demonstrate boost motor assembly readiness for first flight.
THAAD Short Hot Launch Test	10/7/04	First test firing of a THAAD Development Program interceptor from canister on a THAAD launcher. Successfully demonstrated proper egress of the interceptor from its canister. This successful Short Hot Launch Test achieves a major risk reduction milestone on the path towards the first flight test in 2005.

ACRONYMS

AF	Air Force
AST	Arrow System Test
BMC3	Battle Management, Command, Control & Communications
BMDS	Ballistic Missile Defense System
BV	Boost Verification (Test)
BV+	Boost Vehicle (Lockheed Martin Booster)
C2BMC	Command, Control, Battle Management, Communications
CLE	Command Launch Equipment
CM	Cruise Missile
CMOC	Cheyenne Mountain Operations Center
COCOM	Combatant Commander
DB	Data Bridge
DT	Developmental Test
EKV	Exo-Atmospheric Kill Vehicle
ESI	External System Interface
FBX-T	Forward Based X-Band Radar
FM	Flight Mission
GBI	Ground-Based Interceptor
GBR-P	Ground-Based Radar - Prototype
GFC/C	GMD Fire Control, Communications
GMD	Ground-Based Midcourse Defense
GT	Glory Trip
IDC	Initial Defensive Capability
IFT	Integrated Flight Test
IGT	Integrated Ground Test
JNIC	Joint National Integration Center
LDO	Limited Defensive Operations
MDIE	Missile Defense Integration Exercise
OBV	Orbital Boost Vehicle
OT	Operational Test
SBIRS	Space-Based Infrared System
SD	San Diego
SICO	System Integration & Checkout
STN	SBIRS Test Node
TBM	Theater Ballistic Missile
THAAD	Terminal High Altitude Area Defense
USFT	United States Flight Test